(12) **PATENT PUBLICATION (Kokai)** (A)

(19) Japanese Patent Office (JP)

(11) Patent public notice number
Patent Publication 2003-196632
(P2003-196632A)

(43) Publication date: Heisei 15 yr. July 11 (2003. 7. 11)

(51)Int.Cl.[7]	ID Code
G06K 19/077	
B42D 15/10	521
H01L 21/56	
23/28	
// G09F 3/00	

FI		Theme code (reference)
B42D 15/10	521	2C005
H01L 21/56	E	4M109
23/28	Z	5B035
G09F 3/00	M	5F061
G06K 19/00	K	

Examination request: not requested yet
Number of claims: 6, OL (total 13 pages)

(21) Application number:
Patent Application 2001-396925 (P2001-396925)

(22) Filed date:
Heisei 13 yr. December 27 (2001. 12. 27)

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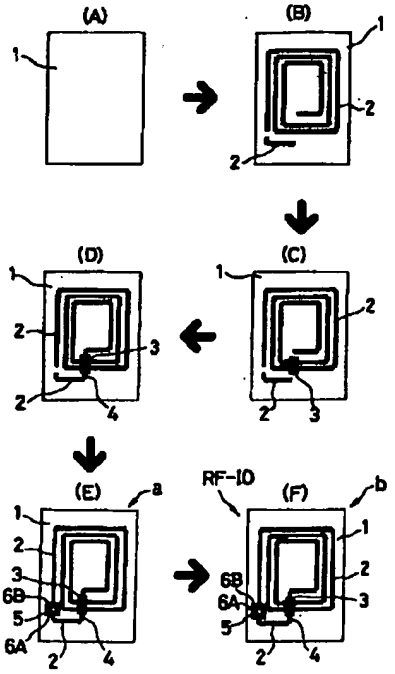
(54) **[Title of the invention]** Production process of IC media

(57) **[Summary]**

[Objective] To provide process to easily produce highly reliable IC media at low cost without bulging up polymer member that protects the IC chip, which hardly contacts with other objects without delamination of IC chip accompanied with this, also causing no partial breakage of sheet when a sheet is laminated, and further, is excellent in bending resistance and resistance against pressure from the top.

[Means to solve] In production method of IC media wherein it is composed by mounting an IC chip on the surface of substrate and a protruding section comprising polymer member is formed around shad IC chip; mount an IC chip on a surface of substrate which is surrounded by a protruding section being formed by placing a metal mask or plastic mask having an opening in specific shape on said substrate, and coating a polymer member by using a squeegee in reverse over it to form a protruding section comprising the polymer member along the inner wall of said opening section on said substrate, then curing/drying as required.



[Patent claims]

[Claim 1] In production method of IC media wherein it is composed by mounting an IC chip on the surface of substrate and a protruding section comprising polymer member is formed around shad IC chip; production method of IC media which is characterized by mounting an IC chip on a surface of substrate which is surrounded by a protruding section being formed by placing a metal mask or plastic mask having an opening in specific shape on said substrate, and coating a polymer member by using a squeegee in reverse over it to form a protruding section comprising the polymer member along the inner wall of said opening section on said substrate, then curing/drying as required.

[Claim 2] In production method of IC media wherein it is composed by mounting an IC chip on the surface of substrate and a protruding section comprising polymer member is formed around shad IC chip and a polymer member layer is formed in tight contact with at least side wall of said IC chip; production method of IC media which is characterized by forming a protruding section comprising polymer member around an IC chip and forming a polymer member layer in tight contact with at least side wall of said IC chip, then curing/drying as required, by placing metal mask or plastic mask having an opening in specific shape on substrate so that the IC chip that has been mounted on said substrate surface is located within said opening section and coating a polymer member by using a squeegee in reverse over it.

[Claim 3] Production process of IC media that is described in Claim 1 or Claim 2 and characterized that said squeegee is a rubber squeegee of hardness 60 degrees to 90 degrees.

[Claim 4] Production process of IC media that is described in one of Claim 1 through Claim 3 and characterized that blade angle ($\theta 1$) of said squeegee is 30 degrees to 80 degrees.

[Claim 5] Production process of IC media that is described in one of Claim 1 through Claim 4 and characterized that squeegee angle ($\theta 2$) of said squeegee is 60 degrees to 90 degrees.

[Claim 6] Production process of IC media that is described in one of Claim 1 through Claim 5 and characterized that pressure force of said squeegee is 0.03 to 0.5 MPa.

[Detail description of the invention]

[0001]

[Technology field this invention belongs] This invention concerns production method of IC media being mounted with an IC chip that is protected in new form, which concerns, for examples, production method of general IC media including information recording media such as contact type, non-contact type or hybrid type IC cards, labels, tags and forms, information recording components such as interposers and inlet sheets, and further such as IC boards being assembled into devices.

[0002]

[Prior technology] Previously, the form of protecting IC chips is to enclose entire IC chip with polymer member (potting agent), therefore, IC media constituted by having thus protected IC chip have been common. For example, the constitution of non-contact type IC media is described here which is used for the applications of information recording media which is able to do such as recording and erasing of data by sending and receiving data in a condition of non-contact wherein the IC media are such as non-contact type IC cards, tags and labels. These IC media have a constitution having an antenna section comprising electro-conductive material being located on a substrate and an IC chip is mounted on the antenna section. For the antenna section of this non-contact type data sending and receiving unit, those which are printed and formed with electro-conductive

paste, for example, and for the IC chip, those which are provided with connection terminals which are to be connected by poking into the terminal section of the antenna section which is located at chip mounting position of the substrate, for example, have been adopted, respectively.

[0003] A process for producing non-contact type IC media is described by using Figure 6. Figure 11 is an explanation drawing for schematically explain the cross section of non-contact IC media being produced in Figure 10. Substrate 1 is prepared in process (A). Antenna sections 2 having a pattern that is shown in the drawing are formed on specific location of surface of the substrate 1 in process (B) by a method such as screen printing using electro-conductive paste and curing/drying. Insulation section 3 that is shown in the drawing is formed in process (C) by a method such as screen printing to form on specific location of the antenna sections 2 using insulation paste then curing/drying. Jumper section 4 is formed in process (D) after forming the insulation section 3 by a method such as screen printing using electro-conductive paste and curing/drying, to connect between two antenna sections in the drawing by making it conductive. An IC chip 5 is mounted in process (E) by a method such as poking to connect terminals 7 of the IC chip 5 between the antenna sections 2 that are located at the chip mounting position being shown in the drawing of the substrate 1, to make conductive. Non-contact IC media is formed in process (F) by covering the mounted IC chip 5 by potting method with thermoset insulation paste comprising polymer member 6 of such as phenolic resin or polyester resin then hardening it to seal the IC chip 5.

[0004]

[Problems that the invention is to solve]

Thus formed IC media have bending resistance and superior in reliability because IC chip 5 is protected so that entire IC chip is enclosed with polymer member (potting material) 6 with potting method, however, bulging up of polymer member is very high compared to the height of the IC chip because it encloses entire IC chip as shown in Figure 11, and as a result, this bulging part is prone to contact with other objects and there has been a danger of delamination of IC chip due to this. Also, there have been a problem that a sheet that is forced to laminate is partially broken by bulging polymer member 6 when laminating a sheet over this IC media, for example when producing a non-contact type IC card. Where, if the polymer member 6 were not used, there will be no case that laminated sheet is broken with the polymer member 6 at making it into a card, however, there are problems that it is inferior in bending resistance and also inferior in resistance against pressure force from the top.

[0005] Accordingly, the inventor discovered that by providing a protruding section comprising resin member around an IC chip, or further forming a resin member layer in tight contact with such as the surface and side wall of the IC chip along with this protruding section, it is able to well protect the IC chip and at the same time, there is no delamination because the IC chip is in tight contact with the substrate via resin member layer, and able to set the height of the polymer member lower than previous ones which enclose entire chip, and as a result, the polymer member is less prone to contact with other objects and there is no delamination of the chip due to this, and further such as partial breakage of the sheet has not been occurred even when a sheet is laminated over this, it is excellent in adhesion between laminated sheet and IC chip, and further, it is excellent in bending resistance and resistance against pressure force from the top. However, forming of a protruding section on substrate has been previously done by such as screen printing process and dispensing process, however, the screen printing process is limited with the amount of

transferred ink even coating thickness is made thicker and has a problem that height from the substrate is not able to be very high, and although the dispense process is able to make the height on the substrate, it has a problem that speed is slow and efficiency is poor. On the other hand, there is a process to produce the protruding section by casting resin in a mold, however, it was difficult to produce molds for small quantity and many kinds at low cost. Therefore, thew inventor discovered that it is able to increase amount of polymer member being transferred without reducing production speed by using a metal mask or a plastic mask and a squeegee and by using the squeegee in reverse instead of using the squeegee in normal direction, and able to more conveniently produce IC media having a protruding section, especially convex shape protruding section, around the IC chip on substrate as a result of research for processes that previously did not exist.

[0006] The objective of this invention is to provide a process for easily producing highly reliable IC media having bending resistance at low cost wherein there is no bulging up of the polymer member that protects IC chip to make it hard to contact with other objects and to eliminate delamination of IC chip due to this, there is no occurrence of such as partial sheet breakage even when a sheet is laminated, and further it is superior in bending resistance and resistance against pressure force from the top.

[0007]

[Means to solve the problems] In order to solve above objectives, the production process of IC media of Claim 1 of this invention is characterized by mounting an IC chip on a surface of substrate which is surrounded by a protruding section being formed by placing a metal mask or plastic mask having an opening in specific shape on said substrate, and coating a polymer member by using a squeegee in reverse over it to form a protruding section comprising the polymer member along the inner wall of said opening section on said substrate, then curing/drying as required; in production method of IC media wherein it is composed by mounting an IC chip on the surface of substrate and a protruding section comprising polymer member is formed around shad IC chip.

[0008] In order to solve above objectives, the production process of IC media of Claim 2 of this invention is characterized by forming a protruding section comprising polymer member around an IC chip and forming a polymer member layer in tight contact with at least side wall of said IC chip, then curing/drying as required, by placing metal mask or plastic mask having an opening in specific shape on substrate so that the IC chip that has been mounted on said substrate surface is located within said opening section and coating a polymer member by using a squeegee in reverse over it; in production method of IC media wherein it is composed by mounting an IC chip on the surface of substrate and a protruding section comprising polymer member is formed around shad IC chip and a polymer member layer is formed in tight contact with at least side wall of said IC chip.

[0009] The production process of IC media of Claim 3 of this invention is characterized that said squeegee is a rubber squeegee of hardness 60 degrees to 90 degrees; in the production process being described in Claim 1 or Claim 2.

[0010] The production process of IC media of Claim 4 of this invention is characterized that blade angle ($\theta 1$) of said squeegee is 30 degrees to 80 degrees; in the production process being described in one of Claim 1 through Claim 3.

[0011] The production process of IC media of Claim 5 of this invention is characterized that squeegee angle ($\theta 2$) of said squeegee is 60 degrees to 90 degrees; in the production process being described in one of Claim 1

through Claim 4.

[0012] The production process of IC media of Claim 6 of this invention is characterized that pressure force of said squeegee is 0.03 to 0.5 MPa; in the production process being described in one of Claim 1 through Claim 5.

[0013] According to the production process of IC media in Claim 1 of this invention, it is able to easily provide a protruding section comprising polymer member around an IC chip, and because of providing this protruding section, it is able to well protect the IC chip and at the same time able to set the height of the polymer member lower (preferably 0.7 to 2 times of IC chip, considering pressure force resistance) than previous ones which enclose entire chip, and as a result, the polymer member is less prone to contact with other objects and there is no delamination of the chip due to this, and further such as partial breakage of the sheet has not been occurred even when a sheet is laminated over this, and further it is able to easily produce IC chips at low cost which are excellent in bending resistance and resistance against pressure force from the top.

[0014] According to the production process of IC media in Claim 2 of this invention, it is able to easily provide a protruding section comprising polymer member around an IC chip and able to easily form a polymer member layer in tight contact with the surface and side wall of said IC chip, and as a result, it is able to well protect the IC chip and at the same time there is no delamination because the IC chip tightly contacts with the substrate with the polymer member layer, and also, able to set the height of the polymer member lower (preferably 0.4 to 2 times of IC chip, considering pressure force resistance) than previous ones which enclose entire chip, and as a result, the polymer member is less prone to contact with other objects and there is no delamination of the chip due to this, and further such as partial breakage of the sheet has not been occurred even when a sheet is laminated over this, and further it is able to easily produce IC chips at low cost which are excellent in bending resistance and resistance against pressure force from the top.

[0015]

[Form of embodiment of the invention]

Embodiment form of the production process of IC media of this invention is described below in detail by showing a non-contact type IC medium (inlet sheet) as the example. By using Figure 1, the first form of embodiment of production process of IC media of this invention is explained. Figure 2 (a) is an explanation drawing that schematically describes cross section of an IC medium (inlet sheet) being produced in Figure 1, and (b) is its plan view explanation drawing. Figure 3 (a) through (d) are explanation drawings that schematically explain the process that prints and forms the protruding section and polymer member layer.

[0016] As shown in Figure 1, substrate 1 is prepared in process (A). Antenna sections 2 having a pattern that is shown in the drawing is formed on specific location of surface of the substrate 1 in process (B) by a method such as screen printing using electro-conductive paste and curing/drying. Insulation section 3 which are show in the drawing are formed in process (C) by a method such as printing the insulation section 3 that is shown in the drawing and curing/drying. After forming the insulation section 3, a jumper section 4 is formed over this insulation section 3 by a method such as screen printing using electro-conductive paste and curing/drying, and connected by making it conductive between two antenna sections 2 in the drawing in process (D).

[0017] In process (E), IC chip 5 is mounted by a method such as inserting connecting terminals 7 of the IC chip 5 to be conductive between antenna sections 2 which are located at the chip mounting location.

[0018] Then after mounting the IC chip 5, a metal mask (or plastic mask) 31 having a

slightly larger opening section than the IC chip 5 as shown in Figure 3 (a), is placed over so that the IC chip 5 comes to almost at the center of said opening section 30 of the metal mask 31. Then thermoset insulation paste 33 of thermoset resin such as phenolic resin or polyester resin is coated using a rubber squeegee 32 in reverse as shown in Figure 3 (b). When thermoset insulation paste 33 is thus coated, a protruding section 6A is printed and formed around the IC chip 5 as shown in Figure 3 (d) and (e), because a part of the tip of flexible rubber squeegee 32 first enters a gap between the IC chip 5 and the opening section 30 during the coating as shown in Figure 3 (c), and when the rubber squeegee 32 moves, a part of the tip of the rubber squeegee 32 moves out of the gap between the IC chip 5 and the opening 30, and at the same time, the polymer member layer 6B is printed and formed in contact with at least side wall of the IC chip. After printing and forming of the protruding section 6A and polymer member layer 6B, the protruding section 6A and polymer member layer 6B are hardened by a method such as curing/drying to form a non-contact IC medium which is shown in Figure 1 (E).

[0019] In process (F), inlet sheet b (namely, a non-contact IC media wherein antenna section 2 and further adhesive layer 8 are provided on a surface of the substrate 1 and on other surface, respectively) is formed by providing an adhesive layer 8 by coating adhesive on back side of the substrate 1 of this formed non-contact IC media.

[0020] Thus produced non-contact IC medium is formed with protruding section 6A comprising polymer member around the IC chip 5, and because the height h of the protruding section 6A is about 0.4 to 2 times of the height of the IC chip 5 as shown in Figure 2 (a), and at this level, there is no case that the sheet is destroyed by the protruding section 6A when at least one layer of sheet is laminated over it, and the IC chip 5 is protected with the protruding section 6A, therefore, it is excellent in resistance against bending and resistance against pressure force from the top without such as breakage of the IC chip 5. Furthermore, because the polymer member layer 6B is formed in contact with the surface and side wall of the IC chip 5, the IC chip 5 is well adhered to the substrate 1 and will not delaminate, and if other sheet is further laminated over it, it will strongly adhere with the IC chip 5, therefore, it is excellent in reliability.

[0021] Even the height h of protruding section 6A is lower than the height of IC chip 5, there is a dispersing effect of load and it is effective, however, if it is less than 0.4 the IC chip 5 will not be well protected when at least one layer of sheet is further laminated over it and therefore resistance against bending and resistance against pressure force from the top are inferior, which reduces reliability.
If height h of the protruding section 6A is made to be high exceeding 2 times of the height t of the IC chip 5, the polymer member is prone to contact with other objects when it is not laminated and danger of delamination of the IC chip is increased, and when a sheet is laminated, there is a danger that the sheet is partially destroyed with the protruding section 6A, which is not desirable.

[0022] In above example, an example was shown wherein the protruding section 6A was formed in continuous square shape around the IC chip 5, however, the shape shall not be restricted within square shape and it may be circular shape, triangular shape, polygonal shape, or mass of dots in undefined shapes.

[0023] Further, the protruding section 6A may not be formed continuously as far at it is formed around the IC chip 5, and it may be formed in discontinuously by forming in uniform distance, non-uniform distance or combination of those. If it is discontinuously formed, electro-conductive materials such as electro-conductive paste may be used for the polymer member that forms the protruding

section 6A, although it is desirable to use insulating material such as insulation paste.

[0024] Figure 4 (a) through (c) are explanation drawings which explain such as the shapes of the protruding section. (a) shows an example which is formed in continuous circular shape around the IC chip 5, (b) shows an example which is formed in discontinuous square shape around the IC chip 5, and (c) shows an example which is formed in discontinuous circular shape around the IC chip 5.

[0025] In above example, an example of forming the protruding section 6A and polymer member layer 6B at process (E) after mounting the IC chip 5 was shown, however, it shall not be restricted within this and it may be formed in process (F).

[0026] In this invention, type of the squeegee is not restricted in specific. However, it is necessary to use the squeegee in reverse. Figure 5 (a) shows normal use of a squeegee, and (b) shows an example of reverse use of a squeegee. Squeegee 32 is normally used as shown in Figure 3* (a). When polymer member 33 is coated by using a squeegee 32 as shown in Figure 3* (a), it is printed in a condition that the polymer member 33 is fully stuffed in the opening section 30, therefore thick coating is available by making the thickness of mask 31 thicker. On the contrary, when the squeegee is used in reverse as shown in Figure 5 (b), a part of the top of the squeegee 32 enters the opening section 30 during coating, the top section moves almost touching the surface of substrate 1, then the squeegee 32 goes out of the opening section 30, therefore, it is able to print/form the protruding section 6A (and polymer member layer 6, although it is not shown in the drawing) along the inner surface of the opening 30 as shown in the drawing.

**Translator's note: These "Figure 3 (a)" shall be a mistake of "Figure 5 (a)".*

[0027] Material of the squeegee may be such as rubber or metal, but materials that do not damage the metal mask or plastic mask, and such as a rubber squeegee and a squeegee that is coated with rubber over a plate of such as metal are preferably used in this invention.

[0028] Hardness of rubber is not restricted in specific, however, hardness based on JIS K6253-1197 / ISO7619 (using a durometer) is preferred to be 60 to 90 degrees, desirably to be 70 to 80 degrees. Under 60 degrees, there is a concern that the tip of squeegee may not be able to scrape out the polymer member 33 in the opening section 30 although it depends on such as viscosity of the polymer member 33, and if the polymer member 33 is not able to be scraped out, it is not able to form good protruding section 6A and polymer member layer 6B. When the hardness exceeds 90 degrees, it is not able to form desired protruding section because the squeegee does not appropriately bends. Also, it is difficult to obtain commercially available product which is not economical.

[0029] Squeegee blade angle of the squeegee 32 (the angle shown by θ1 in Figure 5) is not restricted in specific, however, those with 30 degrees to 80 degrees are preferable and desirably it is preferred to be around 45 degrees. If the squeegee blade angle θ1 is under 30 degrees, the tip of squeegee 32 is narrow and there is a danger that it may not be able to scrape out the polymer component 33 in the opening section 30, and if the squeegee blade angle θ1 exceeds 80 degrees, it looses flexibility and there is a danger that the tip of squeegee 32 may not be able to enter the opening section 30, although it depends on the material too.

[0030] The squeegee angle (angle that is shown by θ2 in Figure 5) is not restricted in specific, however, 60 degrees to 90 degrees is preferable and desirably around 70 degrees to 85 degrees is preferable. With the squeegee angle (θ2) under 60 degrees, there is a danger that the tip of squeegee 32 may not be able to scrape out the polymer component 33 in the

opening section 30, and if the squeegee angle (θ2) exceeds 90 degrees, there is a danger that the tip of squeegee 32 may not be able to scrape out the polymer component 33, too.

[0031] Pressure force of the squeegee 32 is not restricted in specific, however, it is desirable to be 0.03 to 0.5 Mpa. Pressure force of the squeegee 32 is able to be measured by a method that places a pressure sensor on backside of substrate 1 at a location that corresponds the opening section 30 and measure the value of electric current when printing using the squeegee 32 (using such as those which are made by Nitta Bigmat* Co.) or a method that utilizes the breakage of micro capsule when they are pressed (such as Prescale made by Fuji Photo Film Co.). With the pressure force under 0.03 MPa, there is a danger that the tip of squeegee 32 is not able to scrape out the polymer member 33 in the opening section 30, and if the pressure force exceeds 0.5 Mpa, there is a danger that IC chip 5 may be destroyed.

**Translator's note: "Bigmat" is phonetic translation of Japanese company name and original spelling is not known.*

[0032] In this invention, metal mask that is made of metal or plastic mask that is made of plastics are preferably used for the mask. Such as size, thickness and shape of the mask, are not restricted in specific. As the thickness example of the mask, it is able to mention about 50 to 1000 μm, for example. The mask is provided with one or two or more of opening section(s) 30 in advance. Such as size and shape of the opening section 30 shall be designed and produced to match with the IC chip 5, and they shall not be restricted in specific.

[0033] By using Figure 6, the second embodiment form of the IC media of this invention is described. Figure 7 (a) is an explanation drawing that schematically explains cross section of a non-contact type IC medium (inlet sheet) being produced in Figure 6, and (b) is its plan view explanation drawing. As shown in Figure 6, substrate 1 is prepared in process (A). Antenna sections 2 having a pattern that is shown in the drawing are formed on specific location of surface of the substrate 1 in process (B) by a method such as screen printing using electro-conductive paste and curing/drying. Insulation sections 3 and protruding section 6A which are show in the drawing are formed in process (C) by processes such as printing the insulation section 3 as shown in drawing at specific locations of the antenna section 2 by using thermoset insulation paste comprising polymer member 6 of such as phenolic resin or polyester resin, and printing and forming the protruding section 6A comprising the polymer compound to surround the IC chip 5 which is going to be mounted in following process (E), then curing/drying. The protruding section 6A is formed as follows.

[0034] Which is, as shown in said Figure 3 for example, when a metal mask or plastic mask 31 having an opening section 30 is placed over a substrate 1, and polymer member 33 is coated over it using a squeegee 32 in reverse, a protruding section 6A comprising polymer member is formed on the substrate 1 along the inner wall surface of the opening section 30. After forming the protruding section 6A, it is cured and dries as required. After forming the insulation section 3 and protruding section 6A, a jumper section 4 is formed by a method such as screen printing and curing/drying using electro-conductive paste over this insulation section 3 in process (D), to make it conductive between two antenna sections 2 in the drawing to connect. In process (E), IC chip 5 is mounted by a method such as inserting connecting terminals 7 of the IC chip 5 to be conductive between antenna sections 2 which are located at the chip mounting location of substrate 1 being surrounded by the protruding section 6A. In process (F), inlet sheet b (namely, a non-contact IC media wherein antenna section

2 and further adhesive layer 8 are provided on a surface of the substrate 1 and on other surface, respectively) is formed by providing an adhesive layer 8 by coating adhesive on back side of the substrate 1 of this formed non-contact IC media.

[0035] Thus produced non-contact IC medium (inlet sheet) is formed with protruding section 6A comprising polymer member around the IC chip 5, and height h of the protruding section 6A is 0.7 to 2 times of the height t of the IC chip 5 as shown in Figure 7 (a). At this level, a sheet will not be destroyed by the protruding section 6A when at least one layer of sheet is laminated over it, and the IC chip 5 is protected with the protruding section 6A, therefore, it is excellent in resistance against bending and resistance against pressure force from the top without such as breakage of the IC chip 5, thus it is excellent in reliability.

[0036] Although there is an dispersing effect of load and it is effective even if the height h of the protruded section 6A is less than the height t of the IC chip 5, however, if it is less than 0.7 times, it is inferior in bending resistance and resistance against pressure force from the top because the IC chip 5 is not well protected with the protruding section 6A when one layer of sheet is further laminated over it, which reduces reliability. On the other hand, if height h of the protruding section 6A is made to be high exceeding 2 times of the height t of the IC chip 5, the polymer member is prone to contact with other objects when it is not laminated and danger of delamination of the IC chip accompanied with this is increased, and when a sheet is further laminated, there is a danger that the sheet is partially destroyed with the protruding section 6A.

[0037] In above example, an example was shown wherein the protruding section 6A was formed in continuous square shape around the IC chip 5 as shown in Figure 7 (b), however, the shape shall not be restricted within square shape and it may be circular shape, triangular shape, polygonal shape, or mass of dots in undefined shapes, as described above.

[0038] Further, the protruding section 6A may not be formed continuously as far at it is formed around the IC chip 5, and it may be formed in discontinuously by forming in uniform distance, non-uniform distance or combination of those. If it is discontinuously formed, electro-conductive materials such as electro-conductive paste may be used for the polymer member that forms the protruding section 6A, although it is desirable to use insulating material such as insulation paste.

[0039] In above example, an example of forming the protruding section 6A along with the insulation section 3 by using such as insulation paste in process (C) is described, however, the process for forming the protruding section 6A shall not be restricted within this and it may be formed in either process (B), process (D) or process (E) before mounting an IC chip 5, and also it may be formed in process(E) or process (F) which are after mounting the IC chip.

[0040] Either insulation material such as insulation paste or conductive material such as conductive paste may be used for the polymer member that forms the protruding section 6A and polymer member layer 6B. However, use of insulating material such as insulating paste is desirable. As the concrete polymer materials it is able to mention thermally curable or radiation curable hardening resins such as acrylate compounds, methacrylate compounds, propenyl compounds, aryl compounds, vinyl compounds, acetylene compounds, unsaturated polyesters, epoxy-poly-(meth)acrylates, poly-(meth)acrylate polyurethanes, polyester polyol poly(meth)acrylates, polyether polyol poly(meth)acrylates, phenoxy ethyl (meth)acrylates, tetra-hydro-furfuryl (meth)acrylate, styrene, α-alkyl styrene, and other epoxy compounds, for examples. These

may also be used by mixing two or more kinds.

[0041] It is able to add such as liquid poly-butene, mineral oil, liquid poly-isobutylene, liquid poly-acrylates, tackifier, rosin and rosin derivatives, poly-terpene resin, terpene phenolic resin, and petroleum resin. Also, it is able to dilute with organic solvent as necessary.

[0042] Further, it is able to formulate fillers as needed. As the fillers, it is able to mention such as silica, alumina, calcium carbonate, titanium oxide, and carbon black, for examples. These may be used by mixing two or more kinds. Formulating amount of the filler shall not be restricted in specific, however, it is desirable to set at 30 to 85 weight percent to the total of the resin compound.

[0043] The epoxy compound that is used in this invention is not restricted in specific as long as it is an epoxy compound having 2 or more epoxy groups in one molecule and hardens to be resin state, and epoxy compounds which have been known to the public may be used.

[0044] As concrete examples of epoxy compounds, it is able to mention such as bis-phenol A type epoxy compounds, bis-phenol F type epoxy compounds, tetra-bromo-bis-phenol A type epoxy compounds, phenol-novolac type epoxy compounds, cresol-novolac type epoxy compounds, glycidyl ester type epoxy compounds, alicyclic epoxy compounds, hydantoin epoxy compounds, and mixtures of 2 or more kinds of these, for examples.

[0045] In this invention, reactive thinner may be added to the epoxy compounds. As the reactive thinner, epoxy compounds which have one or two or more of epoxy groups in one molecule and are relatively in low viscosity at room temperature are able to be preferably used and they may have other polymerizing functional groups other than the epoxy groups, such as alkenyl groups such as vinyl group and aryl group, and unsaturated carboxylic groups such as (meth)acryloyl groups, for examples, according to the purposes.

[0046] As the hardeners that is used in this invention, such as phenolic resins, acid anhydrides, and amine type compounds may be used. As the phenolic resins, such as phenol novolac resin, cresol novolac resin, naphtol modified phenolic resin, di-cyclo-pentadiene modified phenolic resin and paraxylene modified phenolic resin are mentioned as examples, however, it shall not be restricted within those.

[0047] Formulated amount of the epoxy compound and phenolic resin which is a hardener is desired that OH equivalent in the phenolic resin is 0.3 to 1.5 equivalent to 1 equivalent of epoxy group in the epoxy compound, and 0.5 to 1.2 equivalent is more desirable.

[0048] As the acid anhydride, such as methyl-tetra-hydro-phthalic acid anhydride, methyl-hexa-hydro-phthalic acid anhydride, alkylated tetra-hydro-phthalic acid anhydride, hexa-hydro-phthalic acid anhydride, methyl-himic acid anhydride, and dodecenyl succinic acid are mentioned as examples.

[0049] Formulated ratio of the epoxy compound and acid anhydride is desired that acid anhydride equivalent is 0.6 to 1.0 to 1 equivalent of epoxy group in epoxy compound.

[0050] As the amine compounds, modified poly-amine such as aliphatic poly-amine, aromatic poly-amine, poly-amino-amide, poly-amino-imide, poly-amino-ester and poly-amino-urea are mentioned as examples, however, they shall not be restricted within those. It is also able to use compounds of tertiary amine type, imidazole type, hydrazide type, di-cyano-di-amide type and melamine type.

[0051] Formulated ratio of the epoxy compound and amine compound is desired that amine equivalent is 0.6 to 1.0 to 1

equivalent of epoxy group in epoxy compound.

[0052] It is able to formulate flexibility adding agent as needed to the polymer member that is used in this invention. As the flexibility adding agents, it is able to concretely mention polyester type flexibility adding agents, acrylic type flexibility adding agents, urethane type flexibility adding agents, polyvinyl acetate type flexibility adding agents, thermoplastic elastomer type flexibility adding agents, natural rubber type flexibility adding agents, synthetic rubber type flexibility adding agents, and mixture of two or more kinds of those, as examples. Any of these may be used, however, polyester polyol, polyvinyl alkyl ether and mixture of two or more kinds of those are preferably used because their effect is significant.

[0053] Formulated amount of the flexibility adding agent in the polymer member is not restricted in specific as long as within a range which improves adhesion strength or adds flexibility and elasticity, although it depends on the type of flexibility adding agent, however, it is desirable to set within a range of 30 to 70 weight percent to the total of the polymer member. Under 30 weight percent, flexibility and elasticity may not be added, and over 70 %, adhesion strength may be reduced.

[0054] In this invention, curing promoter may be formulated in order to promote hardening. As the curing promoter, it shall not be restricted in specific but it is able to concretely mention those which have been used as curing promoter for epoxy compound such as imidazole type, tertiary amine type and phosphorous compounds, as examples, and they may be selectively used depending on the objective of use and required curing conditions. These may be used alone or two or more kinds may be used together. Formulating amount of the curing promoter is desired to be set at 0.5 to 2.0 weight percent to the total of the polymer member.

[0055] In this invention, filler may be further formulated to the polymer member. As the fillers, it is able to mention inorganic fine particles, organic fine particles and mixtures of both.

[0055] As concrete examples of the inorganic fine particles it is able to mention such as Mizukasil* P-526, P-801, P-527, P-603, P832, P-73, P-78A, P-78F, P-87, P-705, P-707, P-707D (made by Misusawa Kagaku Co.), Nipsil E200, E220, SS-10F, SS-15, SS-50 (made by Nippon Silica Kogyo Co.), SYLYSIA730, 310 (made by Fuji Sylysia Kagaku Co.) as silica fine particles; such as Brilliant-S15, Unibur-70, PZ, PX, Tunex* E, Vigot-10, Vigoto-15, Unifant-15FR, Brilliant-1500, Homocal* D, Gelton* 50 (made by Shiraishi Kogyo Co.) as calcium carbonate fine particles; Chisan* White SW, SW-B, SW-BL (made by Shiraishi Kogyo Co.) as sulfo-calcium alminate fine particles; such as AL-41G, AL-41, AL-42, AL-43, AL-44, AL-41E, AL-42E, AL-M41, AL-M42, AL-M43, AL-M44, AL-S43, AM-21, AM-22, AM-25, AM-27 (made by Sumitomo Chemical Co.), Aluminum Oxide C (made by Nihon Aerosil Co.) as alumina fine particles; and Titanium Dioxide T805, P25 (made by Nihon Aerosil Co.) as titanium dioxide fine particles, as examples.

**Translator's note: These are phonetical translation of Japanese brand names and original English spellings are not known.*

[0057] As concrete examples of the organic fine particles it is able to mention such as tetra-fluoro-ethylene resin (Teflon (registered trademark) 30J, Mitsui Dupont Fluorochemical Co.), hexa-fluoro-vinylidene resin (Neoflon* CTFE, Daikin Kogyo Co.), tri-fluoro-chloro-ethylene resin (Neoflon* VDF, Daikin Kogyo Co.), hexa-fluoro-propylene resin (Neoflon* FEP, Daikin Kogyo Co.), ethylene-fluoride-propylene copolymer (Teflon (registered trademark) 120J, Mitsui Dupont Fluorochemical Co.), various starch fine particles, acrylic resin fine

particles and methacrylic resin fine particles, as examples. These particles may be used alone or used as a combination of 2 or more kinds.

**Translator's note: "Neoflon "is phonetical translation of Japanese brand name and original English spelling is not known.*

[0058] Formulated amount of the fillers shall not be restricted within specific, however, preferably a range of 30 to 85 weight percent to the total of the polymer member is desirable.

[0059] In this invention, it may be able to further add such as solvent, anti-burning agent such as bromine compound or phosphorous compound, silicone type polymer and anti-foaming agent containing it, carbon black, coloring agent such as organic pigments, coupling agent, tackifier, thixotropy agent, anti-sedimentation agent, anti-oxidation agent and dispersing agent, as required, to the polymer member. Added amount of those is desired to be 35 weight percent or less to the total of the polymer member.

[0060] The polymer member that is used in this invention is produced, for example, by uniformly mixing above described components with an mixer such as homogenizer, then further uniformly dispersing with a kneading machine such as kneader, however, the production process shall not be limited with this method.

[0061] As the substrate being used in this invention it is able to select and use from substrates which are known to the public, such as ceramics, glass; fabric, nonwoven fabric mat, paper of inorganic fibers such as glass fiber and alumina fiber, or organic fibers such as polyester fiber and polyamide fiber, and composite materials of those and thermoset resin or thermoplastic resin; plastics being represented by such as polyethylene, polypropylene, poly-ethylene-terephthalate, polyimide, acrylonitrile-butadiene-styrene copolymer, polyvinylchloride and silicone; and also, plastic substrates such as polyamide type resin substrate, ethylene-vinyl-alcohol copolymer resin substrate, poly-vinyl-alcohol type resin substrate, poly-vinylidene-chloride type resin substrate, polystyrene type resin substrate, polycarbonate type resin substrate, and polyether-sulfone type resin substrate; or those which are applied with surface treatments such as matte treatment, corona discharge treatment, plasma treatment, ultraviolet irradiation treatment, electron beam irradiation treatment, flame plasma treatment and ozone treatment, or various primer treatment, to these.

[0062] For the IC chips being used in this invention, those which are known to the public may be arbitrarily used.

[0063] Further, in the case that this invention is non-contact IC media, the pattern of antenna section 2 may be arbitrarily set corresponding to it. For securely connect and fix the IC chip 5 and antenna section 2, wire bonding or thermoset adhesives which are known to the public are used, and as the thermoset adhesives in concrete, it is able to use such as anisotropic electro-conductive adhesive materials such as ACF (Anisotropic Conductive Film) and ACP (Anisotropic Conductive Paste), or able to use such as insulation adhesive materials (adhesive materials which do not contain conductive material) such as NCF (Non-Conductive Film), NCP (Non-Conductive Paste) or double sticky tape in recent years, and it is able to use such as dispensing method, printing method and spraying method for application. Among those, it is desired to use ACP or NCP and apply with dispensing method or printing method.

[0064] Bump 7 may be formed as needed on connecting terminals of IC chip 5 to be used in this invention by such as metal electrolysis plating, stud, electroless metal plating or fixing of electro-conductive resin.

[0065] When mounting the IC chip 5, pressure as needed and energy such as heat,

light, electromagnetic wave such as radio wave or ultrasonic sound according to adhesive, may be applied. Further, post curing may be done after mounting the IC chip 5 in order to make fixing sufficient.

[0066] For the mask that is used in this invention, metal masks made of metal and plastic masks made of plastics are able to be preferably used. Such as size, thickness and shape of masks are not restricted in specific. It is able to mention about 50 to 1000 μm as the thickness of mask, for example. Opening section(s) of one or two or more as needed are provided in advance. Such as the size and shape of the opening sections shall be designed and produced to match IC chips and they shall not be restricted within specific.

[0067] Figure 8 is an explanation drawing explaining cross section of non-contact type IC card which is formed by using inlet sheet b that is shown in Figure 1 (F) or Figure 6 (F), and Figure 9 is a plan view explanation drawing of the non-contact type IC card. As shown in Figure 8, the non-contact type IC card 20 is laminated with an over sheet material (PVC resin) 9 to the bottom surface of inlet sheet b with adhesive layer 8 and an over sheet material (PVC resin) 11 is laminated to the top surface of the inlet sheet b with adhesive layer 10, and as shown in Figure 9, a company logo 25, necessary printed characters 26 are formed at specific location of on the top surface of the over sheet material (PVC resin) 11.

[0068] Where, above described explanation of embodiment is for explaining this invention and it does not restrict the invention that is described in the Claims, or does not reduce the range. Also, constitution of each part of this invention is not restricted within said form of embodiment and various variations are available within a technical range that is described in the Claims.

[0069]

[Embodiment examples] This invention is further described below with embodiment examples and control examples, however, this invention shall not be restricted with these embodiment examples at all.

[0070] (Embodiment example 1) Using Ohmcoat XR1012-168B (made by Namics Co., Ltd.) as the polymer member (heating condition: 30 minutes curing at 150 °C), an inlet sheet b was made following the process being shown by Figure 1 (A) through (F). It was; height t of IC chip = 200 μm, height h of protruding section 6A = 250 μm, and polymer member layer 6B was formed on the side wall of the IC chip 5 and polymer member layer 6B was formed on the surface in 20 μm thick as well. Then a non-contact type IC card 20 having cross sectional structure that is shown in Figure 8 was produced using this inlet sheet b. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. By using a metal mask (stainless steel) having a circular shape opening section, and using a rubber squeegee in reverse of which edge is wider than the inner diameter of the opening section (squeegee blade angle $\theta 1$ = 45 degrees, one side polished, hardness 80 degrees), and moving at squeegee angle $\theta 2$ = 70 degrees, said polymer member 7 was coated with pressure force of squeegee 6 at 0.1 MPa and velocity of 5 cm/sec..

Bending resistance test: Bending resistance was evaluated by wrapping the inlet sheet around stainless steel rods in various diameters then conducting read/write test. The diameter of smallest stainless steel rod that did not loose communication was measured and the bending resistance was described with this diameter.

Pressure resistance: A non-contact type IC card was placed on a horizontal table and pressure was applied from the top with a pressure rod that has slightly larger diameter than the protruding section, and the force (N: Newton) until the communication was lost was measured. Results of the test were;

bending resistance 20 mm and pressure resistance 50 N or more, which was excellent in bending resistance and pressure resistance.

[0071] (Embodiment example 2) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 1 except for forming a polymer member layer 6B in a thickness of 200 μm on the surface of the IC chip 5, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 50 N, which was excellent in bending resistance and pressure resistance. Adhesion of the IC chip 5 to the over sheet 11 being adhered to top surface of the inlet sheet b of the non-contact type IC card 20 was 7 N, which was excellent in adhesion.

[0072] (Embodiment example 3) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 1 except for making the shape of protruding section 6A to be round shape and forming a polymer member layer 6B in a thickness of 200 μm on the surface of the IC chip 5, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 45 N, which was excellent in bending resistance and pressure resistance.

[0073] (Embodiment example 4) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 1 except for using CRP-X432 (made by Sumitomo Bakelite Co., Ltd.) as the polymer member and forming a polymer member layer 6B in a thickness of 200 μm on the surface of the IC chip 5, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 45 N, which was excellent in bending resistance and pressure resistance.

[0074] (Control example 1) An inlet sheet b and a non-contact type IC card 20 were produced for comparison as same as Embodiment example 1 except for not making the protruding section 6A and polymer member layer 6B, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 30 mm and pressure resistance 25 N, which was inferior in bending resistance and pressure resistance. Adhesion of the IC chip 5 to the over sheet 11 being adhered to top surface of the inlet sheet b of the non-contact type IC card 20 was 4 N, which was poor in adhesion.

[0075] (Control example 2) An inlet sheet b was produced for comparison as same as Embodiment example 1 except for making a polymer member 6 ($h = 250$ μm) using the same polymer member with Embodiment example 1, and not forming a polymer member layer 6B on the side wall and surface of the IC chip 5, and bending resistance test was done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 40 N, which was slightly inferior in bending resistance and pressure resistance. Adhesion of the IC chip 5 to the over sheet 11 being adhered to top surface of the inlet sheet b of the non-contact type IC card 20 was 6 N, which was slightly poor in adhesion.

[0076] (Embodiment example 5) Using Ohmcoat XR1012-168B (made by Namics Co., Ltd.) as the polymer member (heating condition: 30 minutes curing at 150 °C), an

inlet sheet b was made following the process being shown by Figure 6 (A) through (F), then a non-contact type IC card 20 having cross sectional structure that is shown in Figure 7 (a) was produced using this inlet sheet b. It was; height t of IC chip = 200 μm, height h of protruding section 6A = 350 μm. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. By using a plastic mask (polyethylene-terephthalate, PET) having a circular shape opening section, and using a rubber squeegee in reverse of which edge is wider than the inner diameter of the opening section (squeegee blade angle θ1 = 45 degrees, one side polished, hardness 60 degrees), and moving at squeegee angle θ2 = 70 degrees, said polymer member 7 was coated with pressure force of squeegee 6 at 0.2 MPa and velocity of 10 cm/sec.. Results of the test were; bending resistance 20 mm and pressure resistance 50 N or more, which was excellent in bending resistance and pressure resistance.

[0077] (Embodiment example 6) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 5 except for making the shape of protruding section 6A to be round shape and making height h of protruding section = 200 μm, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 45 N, which was excellent in bending resistance and pressure resistance.

[0078] (Embodiment example 7) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 5 except for making the shape of protruding section 6A to be round shape, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 20 mm and pressure resistance 75 N, which was excellent in bending resistance and pressure resistance.

[0079] (Embodiment example 8) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 5 except for using CRP-X432 (made by Sumitomo Bakelite Co., Ltd.) as the polymer member, making the shape of protruding section 6A to be round shape, and making height h of protruding section = 200 μm, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 25 mm and pressure resistance 50 N, which was excellent in bending resistance and pressure resistance.

[0080] (Embodiment example 9) An inlet sheet b and a non-contact type IC card 20 were produced as same as Embodiment example 5 except for using CRP-X432 (made by Sumitomo Bakelite Co., Ltd.) as the polymer member, making the shape of protruding section 6A to be round shape, and making height h of protruding section = 350 μm, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 20 mm and pressure resistance 80 N, which was excellent in bending resistance and pressure resistance.

[0081] (Control example 3) An inlet sheet b and a non-contact type IC card 20 were produced for comparison as same as Embodiment example 5 except for not making the protruding section 6A, and bending resistance test and pressure resistance test were done. It was able to easily laminate an over sheet material 11 (polyvinyl chloride

resin) on the top surface of the inlet sheet b. Results of the test were; bending resistance 30 mm and pressure resistance 25 N, which was inferior in bending resistance and pressure resistance.

[0082] (Control example 4) An inlet sheet b was produced for comparison as same as Embodiment example 5 except for making a polymer member 6 (height of polymer member = 500 μm) that is shown in Figures 10 and 11 using the same polymer member with Embodiment example 5, and bending resistance test was done. Over sheet material 11 (polyvinyl chloride resin) was destroyed and it was not able to laminate an over sheet material 11 (polyvinyl chloride resin) on the top surface of the inlet sheet b, therefore, a non-contact type IC card for comparison was not able to be made, thus pressure resistance test was not able to be done. Result of the test was; bending resistance 15 mm, which was excellent in bending resistance.

[0083]

[Effect of the invention] According to the production method of IC media of this invention, it realizes significant effects that, it is able to well protect IC chips by providing a protruding section, preferably a concave shape protruding section, comprising resin member around an IC chip, and further forming a resin member layer in tight contact with surface and side wall of the IC chip along with this protruding section, and at the same time, there is no delamination because the IC chip tightly contacts with the substrate through the resin member layer, and it is able to set the height of resin member lower compared to previous those which encloses entire IC chip, as a result, the resin member is hard to contact with other objects, and such as partial breakage of the sheet has not been occurred even when a sheet is laminated, excellent in adhesion between laminates sheet and IC chip, and further when producing IC media which are excellent in bending resistance and resistance against pressure force from the top, it is able to increase amount of transferred polymer member without reducing production speed by using a squeegee in reverse instead of using the squeegee in normal direction, and able to more conveniently produce IC media having a protruding section, especially concave shape protruding section, around an IC chip on substrate.

[Brief explanation of the drawings]

[Figure 1] An explanation drawing that explains the first form of embodiment of production process of IC media of this invention.

[Figure 2] (a) is an explanation drawing that schematically explains cross section of non-contact type IC medium (inlet sheet) that is produced in Figure 1, and (b) is its plan view explanation drawing.

[Figure 3] (a) through (d) are explanation drawings which schematically explain the process that prints and forms protruding section and polymer member layer.

[Figure 4] An explanation drawing that explains another example of protruding section.

[Figure 5] (a) is an explanation drawing explaining normal use of squeegee and (b) is an explanation drawing explaining reverse use of squeegee.

[Figure 6] An explanation drawings that explains the second form of embodiment of production process of IC media of this invention.

[Figure 7] (a) is an explanation drawing that schematically explains cross section of non-contact type IC medium (inlet sheet) that is produced in Figure 6, and (b) is its plan view explanation drawing.

[Figure 8] An explanation drawing of cross section of a non-contact type IC card.

[Figure 9] An explanation drawing of plan view of a non-contact type IC card.

[Figure 10] (A) through (F) are explanation drawings of production process of previous non-contact type IC media.

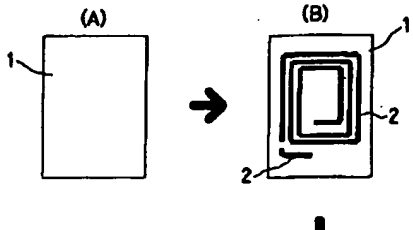
[Figure 11] An explanation drawing explaining a cross section of a non-contact type IC media that is produced in Figure 10.

[Explanation of numbers]

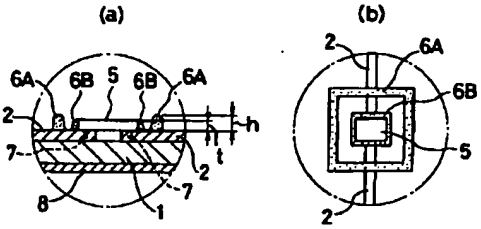
1: substrate
2: antenna section
3: insulator section
4: jumper section
5: IC chip
6: polymer member
6A: protruding section
6B: polymer member layer
8: adhesive layer
20: non-contact type IC card
30: opening section
31: metal mask (or plastic mask)
32: squeegee
33: polymer member
θ1: squeegee blade angle
θ2: squeegee angle
a: non-contact type IC media
b: inlet sheet
h: height of protruding section
t: height of IC chip

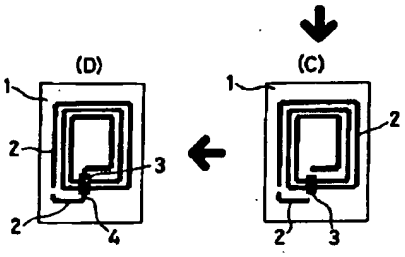
Translated by Hideyo Sugimura, 651-490-0233, hsugimura@pipeline.com, November 30, 2003

[Figure 1]

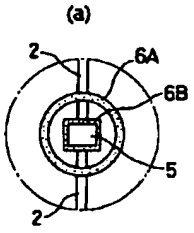


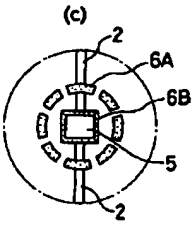
[Figure 2]

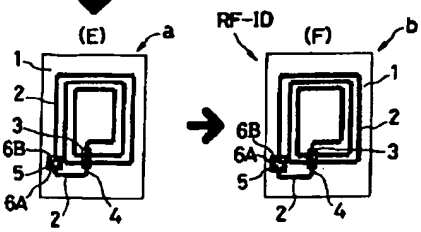




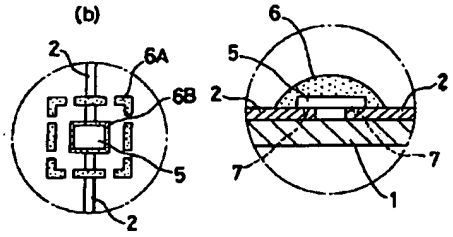
[Figure 4]



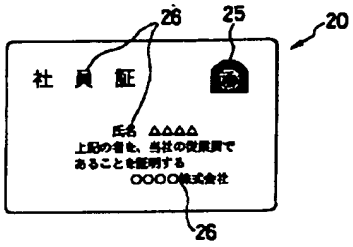




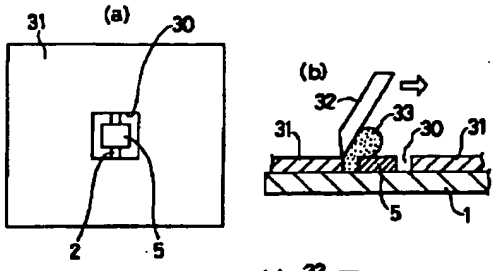
[Figure 11]



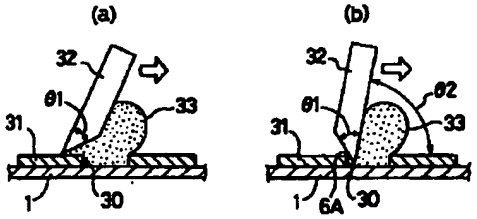
[Figure 9]



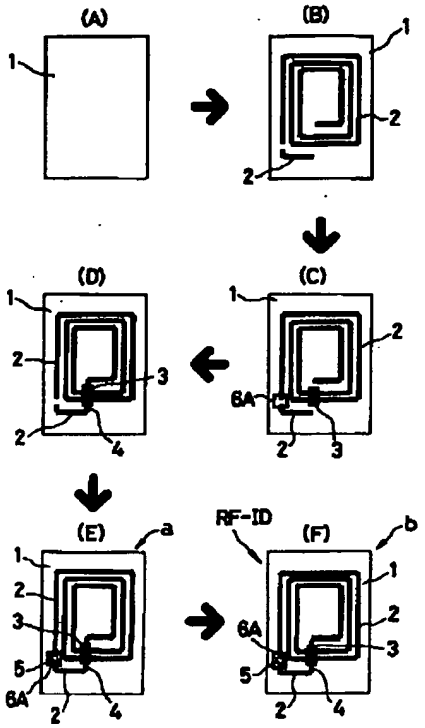
[Figure 3]



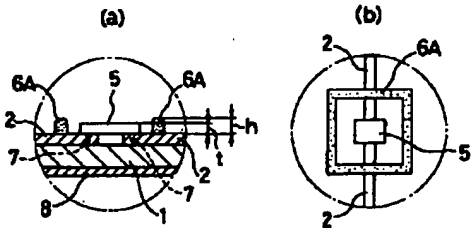
[Figure 5]



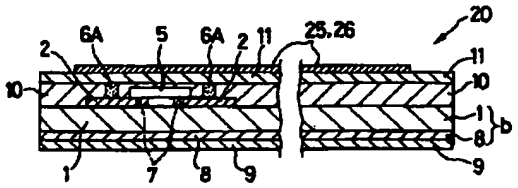
[Figure 6]



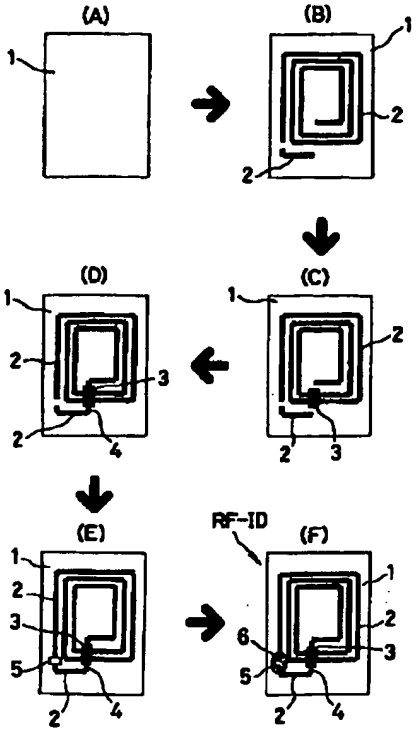
[Figure 7]



[Figure 8]



[Figure 10]



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F term (reference)

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	NA09	NB03	NB06	NB36	NB37
	PA03	PA14	PA17	PA21	RA12
4M109	AA01	BA04	CA12	DB15	
5B035	AA07	AA08	BA05	BA05	BB09
	CA02	CA03	CA23		
5F061	AA01	BA04	CA12		